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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of: **AKAMATSU, et al**

Group Art Unit: 2827

Serial No.: 09/392,722

Examiner: **D. E. GRAYBILL**

Filed: **September 9, 1999**

P.T.O. Confirmation No.: 1679

**FOR: INTEGRATED ELECTRONIC DEVICE HAVING FLIP-CHIP CONNECTION  
WITH CIRCUIT BOARD AND FABRICATION METHOD THEREOF**

**AMENDMENT UNDER 37 CFR §1.111**

Commissioner for Patents  
Washington, D.C. 20231

May 22, 2002

Sir:

In response to the Office Action dated **February 22, 2002**, please amend the above-identified application as follows:

**IN THE CLAIMS:**

Please amend claim 39 as follows:

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39. (Twice Amended) A method for fabricating an integrated electronic device having an electric connection connecting a first electrode of a first substrate with a second electrode of a second substrate, the method comprising the steps of:

forming first and second soldering metal bumps on the surfaces of the first and second electrodes, respectively, a melting temperature of the first soldering metal bump being higher than a melting temperature of the second soldering metal bump;

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aligning the first and second soldering metal bumps to each other, and then keeping both in contact with each other; and

heating the first and second soldering metal bumps to melt the second soldering metal bump at a connection temperature of the first soldering metal bump and solidifying the second soldering metal to form an electric connection between the first and second electrodes, wherein the first surface of the first electrode is not contacted with molten soldering metal throughout an entire manufacturing process the integrated electronic device.

**Please add new claim 42 as follows:**

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42. (New) The method for fabricating an integrated electronic device according to claim 39, wherein the first soldering metal bump is formed in a trapezoidal shape by depositing a first soldering metal through a first mask.

**REMARKS**

Claims 39-42 are pending. Claim 39 is amended and new claim 42 is added. A marked-up version showing the changes made by the present amendment is attached hereto as "Version with markings to show changes made."

**Response to Requirement for Information under 37 CFR §1.105**

The Examiner requires information to support the Amendment filed December 14, 2001. This amendment essentially added the exact equivalent contents of original claims 22 and 23 to the disclosure. In response to the requirement, attached is an English translation of part of the original Japanese priority application related to "silver." A verification of the translation by Junji SAKURAI will be filed shortly.

**Response to Objections and Rejections**

The Examiner again objects to the amendments made September 9, 1999, December 26, 2000 and December 14, 2001, as allegedly introducing new matter. The amendment filed September 9, 1999 added silver as an element which is replaceable for indium of the eutectic alloy. As previously argued, original claim 23 provides support for the amendment. Similarly, the amendment filed December 14, 2001 added sentences to the disclosure corresponding to claims 22 and 23.

It is noted that the Examiner comments on page 6 of the Office Action that such "obvious clerical error" is related to claim construction. Again, it should be noted that claim 23 sets forth "the first metal layer" which finds antecedent support in independent claim 22. No such term appears in claim 21.

In any event, the attached translation of the priority application related to silver serves as evidence that the amendments are supported by the disclosure.

With respect to the Amendment filed December 26, 2000, the phrase "first and second masks" has been deleted from claim 39.

For at least the before reasons, it is submitted that the objections have been overcome.

The rejection of claims 39-41 under 35 USC § 112, second paragraph, has been overcome by deletion of "first and second masks" as noted above.

Claims 39-41 were rejected under 35 USC §103(a) as being unpatentable over the combination of Behun and Hideshima. Favorable reconsideration of this rejection is earnestly solicited.

The Examiner argues in the sentence bridging pages 7 and 8 that it would have been obvious to combine the process of Hideshima with the process of Behun because it would provide first electrodes. However, at column 3, lines 63 through column 4, line 2 in Behun, it is clearly stated that a "low melting point (LMP) solder 16 is applied to bonding pad (*first electrode*) 12. A high melting point (HMP) solder ball 18 is placed in contact with LMP solder 16, and the assembly is heated to reflow the LMP solder, which then wets to the non-molten HMP solder ball" (*italics added*). Accordingly, the bonding pad (*first electrode*) 12 is simultaneously wetted by reflowed LMP solder. In other words, both the bonding pad (*first electrode*) 12 and the non-molten HMP solder ball must have adhesive tendencies to reflowed LMP solder. In claim 1 of Hideshima, it is explicitly stated that the first bump on the first electrode is formed by dipping the semiconductor substrate into molten metal while applying ultrasonic waves thereto.

In both Behun and Hideshima, a soldering bump is formed on the first electrode by contacting the surface of the first electrode with molten metal. In contrast thereto, the soldering bump of the presently claimed invention is formed on the first electrode without melting throughout an entire assembly process from deposition of soldering metal on the first electrode to mounting on the counter circuit board. Therefore, the cited references fail to teach or suggest that an electronic connection between a semiconductor substrate and a circuit board can be formed by connecting a first electrode on the circuit board by soldering bumps without melting the soldering bump on the first electrode.

New claim 42 has been added to specify that the first soldering metal bump is formed in a trapezoidal shape by depositing a first soldering metal through a first metal mask. Support for new claim 42 is provided at page 7, lines 23-27 and in Figs. 2A and 2B. A deposition process of solder paste by a screening mask in Behun inherently can not form a bump in a trapezoidal shape.

For at least the foregoing reasons, the claimed invention distinguishes over the cited art and defines patentable subject matter. Favorable reconsideration is earnestly solicited.

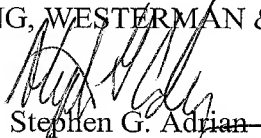
Should the Examiner deem that any further action by applicants would be desirable to place the application in condition for allowance, the Examiner is encouraged to telephone applicants' undersigned attorney.

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In the event that this paper is not timely filed, Applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully Submitted,

ARMSTRONG, WESTERMAN & HATTORI, LLP

  
Stephen G. Adrian  
Attorney for Applicants  
Reg. No. 32,878

SGA/arf

Atty. Docket No. **950637B**  
Suite 1000, 1725 K Street, N.W.  
Washington, D.C. 20006  
(202) 659-2930



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Attachments: Version with markings to show changes made  
Partial translation of JP 06-168385